G 76/985

NEWARK PUBLIC LIBRARY

SEP 2 0 1985

U. S. GOVT. PUBS.
DEPOSITORY 376

Gram-Negative Organisms:

An Approach to Identification

(Guide to Presumptive Identification)

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL

HE 20.7008:

READEX MICRO best copy available

Gram-Negative Organisms: An Approach to Identification
(Guide to Presumptive Identification)

Robert E. Weaver, M.D., Ph.,D.
Dannie G. Hollis, M.S.
Center for Infectious Diseases
Division of Bacterial Diseases

This Guide to Presumptive Identification is also published as an appendix to the CDC laboratory manual on
Identification of Unusual Pathogenic Gram-Negative and Facultatively Anaerobic Bacteria
by W. A. Clark, D. G. Hollis, R. E. Weaver, and P. Riley.
Page numbers correspond to those in the larger manual.

June 1983
Reprinted April 1984
Reprinted August 1985

Use of trade names is for identification only, and does not constitute endorsement by the Public Health Service or by the U.S. Department of Health and Human Services.

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL
ATLANTA, GEORGIA 30333

GRAM-NEGATIVE ORGANISMS: AN APPROACH TO IDENTIFICATION (GUIDE TO PRESUMPTIVE IDENTIFICATION)

Gram-Negative Organisms: An Approach to Identification (Guide to Presumptive Identification) was developed in response to the question, "How can we identify these organisms in the clinical laboratory without doing the total number of tests that are done in a reference laboratory?" The Guide is based on results obtained with conventional procedures (described in the manual *Identification of Unusual Pathogenic Gram-Negative Aerobic and Facultatively Anaerobic Bacteria*).

The Guide consists of three parts: 1) a key for the identification of gram-negative aerobes, 2) 12 tables, and 3) a code book. The key contains 12 categories based on the method by which an organism produces acid from glucose, its ability to grow on MacConkey agar, and the oxidase reaction. There is a corresponding table for each category.

In the key and the tables, a species or unnamed group is considered positive for a "key" characteristic if 90% or more of the strains have been positive for that characteristic. If 11% through 89% of the strains have been positive for that characteristic, the organism is considered to be variable for the characteristic. If only 10% or less of the strains have been positive, the organism is considered to be negative for the characteristic. If a species or unnamed group is variable for one or more of the three "key" characteristics, the species or group is listed in more than one category of the key. For example, if a species ferments glucose 95% of the time, grows on MacConkey agar 65% of the time, and is oxidase-positive 2% of the time, it is listed, because of the variable MacConkey reaction, in two categories of the key (and on the two corresponding tables): 1) glucose fermenters, MacConkey-positive, oxidase-negative and 2) glucose fermenters, MacConkey-negative, oxidase-negative.

The first step in arriving at a presumptive identification is to determine the three key characteristics of the culture being studied. After this has been done, the organism is tested for the additional reactions or characteristics included in the table listing the various species and unnamed groups of bacteria that have the same three key characteristics. For example, if an unknown culture ferments glucose, grows on MacConkey agar, and has a positive oxidase reaction, it should be tested for the additional reactions listed in Table 2: lysine and ornithine decarboxylase, arginine dihydrolase, indole, urease, and fermentation of mannitol, lactose, and sucrose. A presumptive identification is reached by comparing the results obtained in these tests with the reactions listed for the various organisms in the table.

An alternative method for reaching the presumptive identification is to translate the results into a number (the number of digits in the number varies for each table). As shown at the top of each table, each reaction has been assigned a numerical value of 1, 2, or 4. The reactions to be used for calculating the value of each digit are separated by the bold lines. For Table 2 the first digit is determined by the lysine, arginine, and ornithine reactions, the second digit by the indole, urea, and mannitol reactions, and the third digit by the lactose and sucrose reactions. The calculation of the three-digit number for an organism which produces positive reactions for ornithine decarboxylase, indole, urease, and fermentation of sucrose is illustrated below. The number is 432.

To find which organism(s) may produce these reactions, the number 432 is found in the Code Book on the pages titled glucose fermenters, MacConkey-positive, oxidase-positive. The presumptive identification for the organism in the illustration is *Pasteurella pneumotropica*.

	Lysine	Arginine	Ornithine	Indole	Urea	Mannitol	Lactose	Sucrose
Numerical value of positive result	1	2	4	1	2	4	1	2
Test result	—	—	+	+	+	—	—	+
Score of result	0	0	4	1	2	0	0	2
Sum of scores (code number)	4			3			2	

Some of the code numbers may be generated from the reactions produced by more than one species. In these instances the organisms which would produce the number are listed along with additional characteristics which can be used to differentiate those organisms. For example, the reactions of both *Vibrio parahaemolyticus* and *V. vulnificus* may generate the code number 550. The Code Book indicates that the ONPG and cellobiose reactions can be used to differentiate these two species of bacteria.

For each of the tables in the Guide, there is a corresponding set of code numbers. In the Key for Identification of Gram-negative Aerobes, the table number and the pages of the Code Book which correspond to each category of the key are indicated.

The media which can be used to determine the key reactions are:

Triple sugar iron agar
OF glucose
OF base, control
} (mode of glucose utilization)
MacConkey agar (growth)
Blood agar (oxidase test)

The media used for the presumptive identification of gram-negative aerobic bacteria are listed below for each of the 12 tables.

Table 1. Glucose fermenters, MacConkey-positive/oxidase-negative

Urea agar	Lactose broth
Tryptone broth (indole)	Sucrose broth
Lysine, Moeller base	Motility agar (incubate at 35°C)
Arginine, Moeller base	Motility agar (incubate at 25°C)
Ornithine, Moeller base	SS agar slant
Moeller base, control	

Table 2. Glucose fermenters, MacConkey-positive/oxidase-positive

Lysine, Moeller base	Mannitol broth
Arginine, Moeller base	Lactose broth
Ornithine, Moeller base	Sucrose broth
Moeller base, control	20% NaCl solution, sterile
Tryptone broth (indole)	MR broth (optional test)
Urea agar	MR broth with 3% NaCl (optional test)

One drop of the 20% NaCl solution is added to each 1 ml of the Moeller base media and tryptone broth to enhance the growth of sodium-requiring organisms. The use of MR broth (which is essentially void of NaCl) and MR broth with 3% NaCl is to aid in the identification of the sodium-requiring organisms.

Table 3. Glucose fermenters, MacConkey-negative/oxidase-negative

Heart infusion agar slant (catalase)	Maltose broth
Nitrate broth, with insert tube	Xylose broth
Tryptone broth (indole)	Esculin agar slant
Lactose broth	

Table 4. Glucose fermenters, MacConkey-negative/oxidase-positive

Heart infusion agar slant (catalase)	Moeller base, control
Tryptone broth (indole)	Xylose broth
Urea agar	Mannitol broth
Nitrate broth, with insert tube	Sucrose broth
Ornithine, Moeller base	Maltose broth
	Blood agar (hemolysis, if not previously inoculated)

Table 5. Glucose oxidizers, MacConkey-positive/oxidase-negative

OF mannitol	Lysine, Moeller base
OF lactose	Arginine, Moeller base
OF sucrose	Moeller base, control
OF base, control	Esculin agar slant
Nitrate broth, with insert tube	Motility agar

Table 6. Glucose oxidizers, MacConkey-positive/oxidase-positive

Flo agar slant	Urea agar
Tech agar slant	OF xylose
Tryptone broth (indole)	OF mannitol
TSI slant (if not previously inoculated)	OF lactose
Lysine, Moeller base	OF sucrose
Arginine, Moeller base	OF maltose
Moeller base, control	OF base, control
Nitrate broth, with insert tube	

To aid in the identification of apyocyanogenic strains of *Pseudomonas aeruginosa*, it is recommended that cultures also be tested for the ability to grow at 42°C. *P. aeruginosa* grows at 42° while *P. fluorescens* and *P. putida* do not.

Table 7. Glucose oxidizers, MacConkey-negative/oxidase-negative

Urea agar	OF maltose
Tryptone broth (indole)	OF base, control
Nitrate broth, with insert tube	Arginine, Moeller base
OF xylose	Moeller base, control
OF sucrose	

Table 8. Glucose oxidizers, MacConkey-negative/oxidase-positive

Tryptone broth (indole)	OF lactose
Urea agar	OF sucrose
OF xylose	OF maltose
OF mannitol	OF base, control

Table 9. Nonoxidizers, MacConkey-positive/oxidase-negative

OF maltose	Motility agar
OF xylose	Urea agar
OF base, control	Nitrate broth, with insert tube
	Blood agar (hemolysis, if not previously inoculated)

Table 10. Nonoxidizers, MacConkey-positive/oxidase-positive

OF mannitol	SS agar slant
OF xylose	Motility agar
OF base, control	Heart infusion agar slant (incubate at 25°C for flagella stain)
TSI slant (if not previously inoculated)	Nitrite broth, with insert tube (optional test)
Urea agar	
Nitrate broth, with insert tube	

Table 11. Nonoxidizers, MacConkey-negative/oxidase-negative

Urea agar
Nitrate broth, with insert tube
Motility agar

Table 12. Nonoxidizers, MacConkey-negative/oxidase-positive

Tryptone broth (indole)	Nitrate broth, with insert tube
Urea agar	Motility agar
OF xylose	Heart infusion agar slant (catalase)
OF base, control	

NOTES

All strains were not tested in every test.

Symbols:

− = 0−10% +
v = 11−89% +
\+ = 90−100% + within 48 h
+or(+) = <90% + in 48 h, >90% + in 3-7 days

Test results are recorded as above; numbers are percent-positive reactions.

Some *Bacillus* species may give a negative Gram stain reaction. The possibility that an organism, particularly if it does not grow on MacConkey agar, may be a *Bacillus* species should be considered if it can not be identified as a species of gram-negative bacteria.

Microscopic morphology is important for the recognition of some genera such as *Neisseria* and *Campylobacter*.

GUIDE TO PRESUMPTIVE IDENTIFICATION: KEY

GLUCOSE FERMENTERS

Table No.		Code Book Page(s)
	MacConkey-positive	
1	Oxidase-negative	361
	Chromobacterium violaceum, Enterobacteriaceae, Haemophilus aphrophilus, HB-5, *Tatumella ptyseos, Yersinia enterocolitica, Y. pestis, Y. pseudotuberculosis.*	
2	Oxidase-positive	361-362
	Actinobacillus equuli, A. lignieresii, A. suis, Aeromonas hydrophila, Chromobacterium violaceum, EF-4a, *Haemophilus aphrophilus,* HB-5, *Kingella kingae, Neisseria mucosa, N. sicca, N. subflava, Pasteurella aerogenes, P. gallinarum, P. haemolytica, P. pneumotropica, Plesiomonas shigelloides, Vibrio alginolyticus, V. anguillarum, V. cholerae* (0:1 Group and other 0 Groups), *V. damsela, V. fluvialis, V. hollisae, V. parahaemolyticus, V. vulnificus.*	
	MacConkey-negative	
3	Oxidase-negative	363
	Actinobacillus actinomycetemcomitans, Capnocytophaga spp. (DF-1), DF-3, *Gardnerella vaginalis, Haemophilus aphrophilus,* HB-5, *Pasteurella multocida*, P. pneumotropica*, P. ureae*, Pasteurella* sp. "n. sp. 1."*	
4	Oxidase-positive	364-366
	Actinobacillus actinomycetemcomitans, A. equuli, A. lignieresii, A. suis, Cardiobacterium hominis, DF-2, EF-4a, *Haemophilus aphrophilus,* HB-5, *Kingella denitrificans, K. indologenes, K. kingae, Neisseria lactamica, N. mucosa, N. sicca, N. subflava, Pasteurella gallinarum, P. haemolytica, P. multocida, P. pneumotropica, P. ureae, Pasteurella* sp. "n. sp. 1", *Vibrio anguillarum, V. hollisae.*	

GLUCOSE OXIDIZERS

	MacConkey-positive	
5	Oxidase-negative	367-368
	Acinetobacter calcoaceticus (A. anitratus), Brucella canis, Pseudomonas cepacia, P. mallei, P. maltophilia, P. marginata, P. paucimobilis, Ye-1, Ye-2.	
6	Oxidase-positive	368-373
	Achromobacter xylosoxidans, Agrobacterium radiobacter, Brucella abortus, B. canis, B. melitensis, B. suis, EF-4b, EO-2, *Flavobacterium breve, F. meningosepticum, F. multivorum, F. spiritivorum, Flavobacterium* sp. (IIb), *Pseudomonas aeruginosa, P. cepacia, P. diminuta, P. fluorescens, P. mallei, P. mendocina, P. mesophilica, P. paucimobilis, P. pickettii, P. pseudomallei, P. putida, P. putrefaciens* biotype 1, *P. stutzeri, P. thomasii, P. vesicularis,* Ya-1, Yb-3, Yd (*Achromobacter* sp.).	

*Included in this section because oxidase reaction may vary with the reagent used.

Table No.		Code Book Page(s)
	MacConkey-negative	
7	Oxidase-negative . . . . . *Brucella canis, Francisella tularensis, Pseudomonas mallei, P. paucimobilis,* IIe.	373
8	Oxidase-positive . . . . . *Brucella abortus, B. canis, B. melitensis, B. suis,* EF-4b, EO-2, *Flavobacterium meningosepticum, F. spiritivorum, Flavobacterium* species (IIb), *Neisseria gonorrhoeae, N. lactamica, N. meningitidis, Pasteurella anatipestifer, Pseudomonas mallei, P. mesophilica, P. paucimobilis, P. vesicularis,* IIe, IIh, IIi.	373-374

NONOXIDIZERS

	MacConkey-positive	
9	Oxidase-negative . . . . . *Acinetobacter calcoaceticus (A. lwoffi), Bordetella parapertussis, Brucella canis, Pseudomonas maltophilia.*	375
10	Oxidase-positive . . . . . *Achromobacter xylosoxidans, Alcaligenes denitrificans, A. faecalis, A. odorans, Bordetella bronchiseptica, Brucella abortus, B. canis, B. melitensis, Campylobacter fetus* subsp. *fetus, C. fetus* subsp. *jejuni, Flavobacterium odoratum,* M-5, M-6, *Moraxella atlantae, M. osloensis, M. phenylpyruvica, M. urethralis, Neisseria flavescens, N. mucosa, N. sicca, N. subflava, Pseudomonas acidovorans, P. alcaligenes, P. diminuta, P. mesophilica, P. pseudoalcaligenes, P. putrefaciens* biotype 1, *P. putrefaciens* biotype 2, *P. testosteroni, P. vesicularis, Pseudomonas* sp. CDC Group 1, IVc-2 IVe, Vd (*Achromobacter* sp.).	375-377
	MacConkey-negative	
11	Oxidase-negative . . . . . *Brucella canis, Francisella tularensis.*	377
12	Oxidase-positive . . . . . *Bordetella pertussis, Branhamella catarrhalis, Brucella abortus, B. canis, B. melitensis, Campylobacter fetus* subsp. *fetus, C. fetus* subsp. *jejuni, C. fetus* subsp. *venerealis, Eikenella corrodens,* M-5, M-6, *Moraxella atlantae, M. bovis, M. lacunata, M. nonliquefaciens, M. osloensis, M. phenylpyruvica, Neisseria elongata, N. flavescens, N. mucosa, N. sicca, N. subflava, Pseudomonas mesophilica, P. vesicularis,* IIf, IIj, IVe.	377-378

Table 1: Glucose Fermenters, MacConkey-positive/oxidase-negative

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Urea	Indole	Lysine	Arginine	Ornithine	Lactose	Sucrose	Motility 35°C	Motility 25°C	Growth on SS
Numerical Value of Positive Result					1	2	4	1	2	4	1	2	4	1
Chromobacterium violaceum	37	+ 100	+ 100	V 67	V 5(14)	V 21	− 0	+ 100	− 0	− 0	V 20(6)	+ *	+	+ or (+) 71(23)
Enterobacteriaceae		+	+	−										
Haemophilus aphrophilus	203	+ 98(2)	V 19	V 28	− 0	− 0	− 0	− 0	− 0	+ 96(4)	+ 99(1)	−	−	− 0
HB-5	44	+ 100	V 34(23)	V 54	− 0	+ 100	− 0	− 0	− 0	− 0	− 0	−	−	− 0
Tatumella ptyseos	41	+ 100	+ 93	− 7	− 0	− 0	− 0	V 12	− 0	− 0	+ 100	−	V	− 2
Yersinia enterocolitica	83	+ 100	+ 100	− 0	+ or (+) 70(30)	V 79(1)	− 0	− 0	+ 100	V 18(18)	+ 98	−	+	+ 90(6)
Yersinia pestis	37	+ 100	+ 100	− 0	− 0	− 0	− 0	− 0	− 0	− 0	− 0	−	−	− 3(3)
Yersinia pseudotuberculosis	34	+ 100	+ 100	− 3	+ 100	− 0	− 0	− 0	− 0	− 0	− 0	−	V	V 17(41)

*Where blank spaces occur either the percentages were not calculated or they were not available.

Code Book Page 361

Table 2: Glucose Fermenters, MacConkey-positive/oxidase-positive

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Lysine	Arginine	Ornithine	Indole	Urea	Mannitol	Lactose	Sucrose
Numerical Value of Positive Result					1	2	4	1	2	4	1	2
Actinobacillus equuli	19	+ 100	V 84(5)	+ 100	– 0	– 0	– 0	– 0	+ 100	+ 100	+ 95	+ 100
Actinobacillus lignieresii	30	+ 96(4)	V 67(8)	+ 100	– 0	– 0	– 0	– 0	+ 100	+ 91(9)	V 17(61)	+ 96(4)
Actinobacillus suis	33	+ 94(6)	+ or(+) 82(12)	+ 100	– 0	– 0	– 0	– 0	+ 97(3)	V 54	+ or(+) 79(18)	+ 94(6)
Aeromonas hydrophila	115	+ 97(3)	+ 100	+ 99	V 17	+ 99	– 0	+ 92	– 2	+ 100	V 20(9)	V 87(1)
Chromobacterium violaceum	37	+ 100	+ 100	V 67	– 0	+ 100	– 0	V 21	V 5(14)	– 0	– 0	V 20(6)
EF-4a	97	+ 100	V 42(8)	+ 100	– 0	V 77(2)	– 0	– 0	– 0	– 0	– 0	– 0
Haemophilus aphrophilus	203	+ 98(2)	V 19	V 28	– 0	– 0	– 0	– 0	– 0	– 0	+ 96(4)	+ 99(1)
HB-5	44	+ 100	V 34(22)	V 54	– 0	– 0	– 0	+ 100	– 0	– 0	– 0	– 0
Kingella kingae	33	+ or(+) 42(48)	V 33(3)	+ 100	–	–	–	– 0	– 0	– 0	– 0	– 0
Neisseria mucosa	30	+ or(+) 83(10)	V 57(3)	+ 100	–	–	–	–	– 0	– 0	– 0	+ 90(10)
Neisseria sicca	43	+ or(+) 78(14)	V 68	+ 100	–	–	–	–	– 0	– 0	– 0	+ 92(8)
Neisseria subflava	153	V 68(6)	V 47(2)	+ 100	–	–	–	–	– 0	– 0	– 0	V 56(5)
Pasteurella aerogenes	16	+ 100	+ 100	+ 100	– 0	– 0	V 88	– 0	+ 100	– 6	V 19(38)	+ 94
Pasteurella gallinarum	10	+ 90(10)	V 20(10)	+ 90	– 0	– 0	V 25	– 0	– 0	– 0	– 0	+ 100
Pasteurella haemolytica	67	+ 96(4)	V 79(6)	+ 95	– 3	– 0	– 10	– 0	– 0	V 30(9)	V 7(34)	+ 97(3)
Pasteurella pneumotropica	107	+ 97(3)	V 36(17)	+ 99	V 33	– 0	+ 100	+ 90	+ 95(1)	– 2(1)	V 14(39)	+ 97(3)
Plesiomonas shigelloides	28	+ 96(4)	+ 100	+ 96	+ 100	+ 100	+ 100	+ 96	– 0	– 0	+ 92(4)	– 0
Vibrio alginolyticus	58	+ 100	+ 100	+ 100	+ 100	– 0	V 57	+ 90	– 4	+ 100	– 0	+ 100
Vibrio anguillarum	1	+	(+)	+	–	+	–	+	–	+	–	+
Vibrio cholerae (0:1 Group and other O Groups)	82	+ 100	+ 100	+ 100	+ 100	– 0	+ 99	+ 100	– 4(3)	+ 96(2)	V 11(28)	+ 90
Vibrio damsela	23	+ 100	+ 100	+ 91	V 27(4)	+ 100	– 0	– 0	+ 100	– 0	– 0	– (9)
Vibrio fluvialis	25	+ 100	+ 92(8)	+ 100	– 0	+ 96	– 0	V 24	– 0	+ 100	– (8)	+ 100
Vibrio hollisae	12	+ 100	V 64(14)	+ 100	– 0	– 8	– 0	+ 100	– 0	– 0	– 0	– 0
Vibrio parahaemolyticus	160	+ 100	+ 100	+ 100	+ 100	– 0	+ 98(1)	+ 100	– 8	+ 98(1)	– 0	– 2
Vibrio vulnificus	47	+ 100	+ 100	+ 100	+ 100	– 0	+ or(+) 89(8)	+ 100	– 0	V 62	+ or(+) 87(11)	– 2

Code Book Pages 361-362

Table 3: Glucose Fermenters, MacConkey-negative/oxidase-negative

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Catalase	Nitrate Reduction	Indole	Lactose	Maltose	Xylose	Esculin Hydrolysis
Numerical Value of Positive Result					1	2	4	1	2	4	1
Actinobacillus actinomycetemcomitans	120	+or(+) 83(16)	– 4(1)	V 19	+ 99	+ 100	– 0	– 0	+or(+) 80(15)	V 33(9)	– 0
Capnocytophaga spp. (DF-1)	155	+ 90(10)	– 0	– 7	– 7	V 63	– 0	V 75(11)	+or(+) 86(14)	– 0	V 81(2)
DF-3	21	+or(+) 86(14)	– 0	– 0	– 0	– 0	V 71(14)	+or(+) 52(43)	+or(+) 81(19)	+or(+) 86(14)	+ 100
Gardnerella vaginalis	126	+or(+) 81(13)	– 5	– 6	– 2	– 0	– 0	– (1)	+or(+) 87(13)	V 36(9)	– 0
Haemophilus aphrophilus	203	+ 98(2)	V 19	V 28	– 5	+ 100	– 0	+ 96(4)	+ 99(1)	– 0	– 0
HB-5	44	+ 100	V 34(23)	V 54	– 2	+ 100	+,w 100	– 0	– 0	– 0	– 0
Pasteurella multocida	306	+ 100	– 2(1)	+ 97	+ 98	+ 99	+ 99	– 8	– 2	V 67	– 0
Pasteurella pneumotropica	107	+ 97(3)	V 36(17)	+ 99	+ 100	+ 100	+ 90	V 14(39)	+ 97(3)	+or(+) 76(19)	– 0
Pasteurella ureae	97	+ 100	– 0	+ 99	V 63	+ 99	– 0	– 0	+ 91(5)	– 0	– 0
Pasteurella sp., "n. sp. 1"	91	+ 100	– 1	+ 98	+ 96	+ 100	+ 100	– 3	+ 100	– 0	– 0

Code Book Page 363

Table 4: Glucose Fermenters, MacConkey-negative/oxidase-positive

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Catalase	Indole	Urea	Nitrate reduction	Nitrate to gas	Ornithine Decarboxylase	Xylose	Mannitol	Sucrose	Maltose	Beta-like Hemolysis
Numerical Value of Positive Result					1	2	4	1	2	4	1	2	4	1	2
Actinobacillus actinomycetemcomitans	120	+or(+) 83(16)	– 4(1)	V 19	+ 99	– 0	– 0	+ 100	– 0	–	V 33(9)	V 66(16)	– 0	+or(+) 80(15)	– 0
Actinobacillus equuli	19	+ 100	V 84(5)	+ 100	V 68(5)	– 0	+ 100	+ 100	– 0	– 0	+ 100	+ 100	+ 00	+ 95	– 0
Actinobacillus lignieresii	30	+ 96(4)	V 67(8)	+ 100	V 89	– 0	+ 100	+ 100	– 0	– 0	+or(+) 87(13)	+ 91(9)	+ 96(4)	+or(+) 83(17)	– 4
Actinobacillus suis	33	+ 94(6)	+or(+) 82(12)	+ 100	V 85	– 0	+ 97(3)	+ 100	– 0	– 0	+ 94(6)	V 54	+ 94(6)	+ 94(6)	V 76
Cardiobacterium hominis	65	+or(+) 80(20)	– 0	+ 100	– 1	+ 100	– 0	– 0	–	–	– 0	+or(+) 52(43)	+or(+) 63(35)	+or(+) 69(31)	– 0
DF-2	27	V 67(18)	– 0	+ 96	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	– 0	– 0	+or(+) 81(19)	– 4
EF-4a	97	+ 100	V 42(8)	+ 100	+ 100	– 0	– 0	+ 97	V 62	– 0	– 0	– 0	– 0	– 0	– 1
Haemophilus aphrophilus	203	+ 98(2)	V 19	V 28	– 5	– 0	– 0	+ 100	– 0	– 0	– 0	– 0	+ 99(1)	+ 99(1)	– 0
HB-5	44	+ 100	V 34(23)	V 54	– 2	+ 100	– 0	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	– 0
Kingella denitrificans	60	+or(+) 30(62)	– 0	+ 100	– 10	– 0	– 0	+ 93	V 88	–	– 0	– 0	– 0	– 0	– 0
Kingella indologenes	1	+	–	+	–	+	–	–	–	–	–	–	+	(+)	–
Kingella kingae	33	+or(+) 42(48)	V 33(3)	+ 100	– 0	– 0	– 0	– 3(3)	– 0	–	– 0	– 0	– 0	+or(+) 76(24)	V 84
Neisseria lactamica	287	+ 96(3)	– 0	+ 100	+ 100	–	– 0	– 0	–	–	–	– 0	– 0	+ 98(2)	– 0
Neisseria mucosa	30	+or(+) 83(10)	V 57(3)	+ 100	+ 100	–	– 0	+ 100	+ 100	–	–	– 0	+ 90(10)	+ 90(10)	– 0
Neisseria sicca	43	+or(+) 78(14)	V 68	+ 100	V 80	–	– 0	– 0	–	–	–	– 0	+ 92(8)	+ 95(5)	– 7
Neisseria subflava	153	V 68(6)	V 47(2)	+ 100	V 80	–	– 0	– 0	–	–	–	– 0	V 56(5)	+ 99(1)	– 9
Pasteurella gallinarum	10	+ 90(10)	V 20(10)	+ 90	+ 100	– 0	– 0	+ 100	– 0	V 25	V 33	– 0	+ 100	+ 100	– 0
Pasteurella haemolytica	67	+ 98(2)	V 79(6)	+ 95	V 84(2)	– 0	– 0	+ 100	– 0	– 10	V 66(3)	V 30(9)	+ 97(3)	+or(+) 85(13)	V 72
Pasteurella multocida	306	+ 100	– 2(1)	+ 97	+ 98	+ 99	– 0	+ 99	– 0	+ 94	V 67	V 78	+ 100	– 2	– 0
Pasteurella pneumotropica	107	+ 97(3)	V 36(17)	+ 99	+ 100	+ 90	+ 95(1)	+ 100	– 0	+ 100	+or(+) 76(19)	– 2(1)	+ 97(3)	+ 97(3)	– 0
Pasteurella ureae	97	+ 100	– 0	+ 99	V 63	– 0	+ 100	+ 99	– 0	– 0	– 0	+ 99(1)	+ 99(1)	+ 91(5)	– 0
Pasteurella sp., "n. sp. 1"	91	+ 100	– 1	+ 98	+ 96	+ 100	V 78(3)	+ 100	– 0	– 0	– 0	– 0	+ 99	+ 100	– 0
Vibrio anguillarum	1	+	(+)	+	+	+	–	+	–	–	–	+	+	+	+
Vibrio hollisae	12	+ 100	V 64(8)	+ 100	+ 100	+ 100	– 0	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	V 50

Code Book Pages 364-366

Table 5: Glucose Oxidizers, MacConkey-positive/oxidase-negative

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	OF Mannitol	OF Lactose	OF Sucrose	Nitrate Reduction	Lysine	Arginine	Esculin Hydrolysis	Motility
Numerical Value of Positive Result					1	2	4	1	2	4	1	2
Acinetobacter calcoaceticus (A. anitratus)	501	+ 100	+ 99(1)	– 0	– 2	+ 97(2)	– 0	– 1	–	–	– 0	– 0
Brucella canis	28	+ or(+) 81(14)	V 12(29)	V 72	– 0	– 0	– 0	+ 100	–	–	– 0	– 0
Pseudomonas cepacia	159	+ 100	+ 100	V 86	+ 100	+ 99(1)	V 86(1)	V 57	V 80	– 0	V 63(6)	+
Pseudomonas mallei	8	+ 100	V 88	V 25	V 62(14)	V 12(62)	– 0	+ 100	– 0	+ 100	– 0	– 0
Pseudomonas maltophilia	228	+ or(+) 85(5)	+ 100	– 0	– 0	V 60(1)	V 63(1)	V 39	+ 93	– 0	V 39	+
Pseudomonas marginata	1	+	+	–	+	–	–	–	–	–	–	+
Pseudomonas paucimobilis	134	+ 93(7)	V 10(13)	V 75	– 0	+ 93(7)	+ 93(7)	– 3	– 0	– 8	+ 91	V
Ye-1	18	+ 100	+ 100	– 0	V 82(6)	V 6(28)	– 6	V 67	– 0	+ 100	+ 100	+
Ye-2	36	+ 100	+ 100	– 0	+ 100	V 14(22)	V 25	– 6	– 7	V 14	– 0	+

Code Book Pages 367-368

Table 6: Glucose Oxidizers, MacConkey-positive/oxidase-positive

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Pyocyanin	Pyoverdin (Fluorescin)	Indole	H_2S, TSI	Lysine Decarboxylase	Arginine Dihydrolase	Nitrate Reduction	Nitrate to Gas	Urea	OF Xylose	OF Mannitol	OF Lactose	OF Sucrose	OF Maltose
Numerical Value of Positive Result					1	2	4	1	2	4	1	2	4	1	2	4	1	2
Achromobacter xylosoxidans	135	V 78	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	V 13	+ 100	V 60	– 0	+ 99	– 0	– 0	– 0	– 0
Agrobacterium radiobacter	38	+ 100	+ 100	+ 100	– 0	– 0	– 0	V 8(5)	– 0	– 3	V 87	– 5	+or(+) 89(11)	+ 100	+ 100	+ 100	+ 100	+ 100
Brucella species	347	+or(+) 80(10)	V 23(27)	+ 92	– 0	– 0	– 0	– 0	–	–	+ 100	V 44	+ 99	+ 90(10)	– 0	– 0	– 0	– 0
EF-4b	34	+or(+) 70(26)	V 65(6)	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	+ 97	– 0	– 0	– 0	– 0	– 0	– 0	– 0
EO-2	93	+ 100	V 63(11)	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	V 85	– 2	V 74(3)	+ 99(1)	V 10(10)	+ 91(6)	– 0	V 20(1)
Flavobacterium breve	3	+ 100	+ 100	+ 100	– 0	– 0	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	– 0	– 0	– 0	– 0	+ 100
Flavobacterium meningosepticum	148	+ 95(4)	V 89(3)	+ 99	– 0	– 0	+ 100	– 0	–	–	– 0	–	– 3(5)	– 2(1)	+ 91(8)	V 42(15)	– 0	+ 93(7)
Flavobacterium multivorum	22	+ 100	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	– 0	– 0	+ 95	+ 100	– 0	+ 100	+ 100	+ 100
Flavobacterium spiritivorum	11	+ 100	V (55)	+ 100	– 0	– 0	– 0	– 0	– 0	V 25	– 0	– 0	+or(+) 55(36)	+ 91(9)	+ 100	+ 100	+ 100	+ 100
Flavobacterium sp. (IIb)	155	+ 92(6)	V 54(9)	+ 96	– 0	– 0	+ 98	– 1	–	–	V 22	– 0	V 14(28)	V 30(1)	– 10	– 0	V 13(1)	+ 92(6)
Pseudomonas aeruginosa	201	+ 97(1)	+ 100	+ 99	V 46	V 65	– 0	– 0	– 0	+ 100	+ 98	+ 93	V 48(9)	+ 90(1)	V 70(3)	– 1	– 0	– (1)
Pseudomonas cepacia	159	+ 100	+ 100	V 86	– 0	– 0	– 0	– 0	V 80	– 0	V 57	– 0	V 60(18)	+ 100	+ 100	+ 99(1)	V 86(1)	+ 99(1)
Pseudomonas diminuta	68	V 21(9)	+ 97(3)	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	– 3	– 0	V (13)	– 0	– 0	– 0	– 0	– 0
Pseudomonas fluorescens	155	+ 100	+ 100	+ 97	– 0	+ 96	– 0	– 0	– 0	+ 97	V 19	– 3	V 21(31)	+ 100	V 53(2)	V 24(3)	V 48	– 2
Pseudomonas mallei	8	+ 100	V 88	V 25	– 0	– 0	– 0	– 0	– 0	+ 100	+ 100	– 0	V 12	V 12(50)	V 62(14)	V 12(62)	– 0	V (75)
Pseudomonas mendocina	3	+ 100	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	+ 100	+ 100	+ 100	V 33	+ 100	– 0	– 0	– 0	– 0
Pseudomonas mesophilica	90	V 40	V 15	+ 96	– 0	– 0	– 0	– 0	–	–	V 25	– 0	V 29(26)	+ 94	– 2	– 0	– 0	– 2
Pseudomonas paucimobilis	134	+ 93(7)	V 10(13)	V 75	– 0	– 0	– 0	– 0	– 0	– 8	– 3	– 0	– 6(3)	+ 96(4)	– 0	+ 93(7)	+ 93(7)	+ 97(3)
Pseudomonas pickettii	54	+ 100	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	+ 100	+ 100*	+ 100	+ 100	– 0	– 0	– 0	– 0
Pseudomonas pseudomallei	70	+ 100	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	+ 100	+ 100	+ 100*	V 13(8)	+or(+) 86(14)	+ 94(6)	+ 99(1)	V 66(4)	+ 99(1)
Pseudomonas putida	16	+ 100	+ 100	+ 100	– 0	+ 93	– 0	– 0	– 0	+ 100	– 0	– 0	V 13(44)	+ 100	V 25	V 25(13)	– 0	V 31
Pseudomonas putrefaciens, biotype 1	24	V 17(33)	+ 100	+ 100	– 0	– 0	– 0	+ 96	– 0	– 0	+ 100	– 0	V 4(8)	– 0	– 0	– 0	+ 96(4)	+ 92(8)
Pseudomonas stutzeri	28	+ 96(4)	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	+ 100	+ 100	V 33(22)	+ 93(7)	+or(+) 89(4)	– 0	– 0	+ 100
Pseudomonas thomasii[a]	31	+ 100	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	– 3	V 13	– 0	+or(+) 81(19)	+ 100	+ 100	+ 100	– 0	+ 100
Pseudomonas vesicularis	47	+or(+) 87(9)	V 81(8)	+ 94	– 0	– 0	– 0	– 0	– 0	– 0	– 6	– 0	– (8)	V 21(2)	– 0	– 0	– 0	+ 98(2)
Ya-1[b]	70	+ 100	+ 99(1)	+ 100	– 0	– 0	– 0	– 0	– 0	– 6	+ 100	V 86	+ 100	+ 100	– 0	+ 100	– 0	+ 100
Yb-3	65	+ 100	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	+ 100	+ 100	+ 100	V 12(45)	+ 97(3)	V 65(9)	– 0	– 0	+ 95(5)
Yd (*Achromobacter* sp.)	71	+or(+) 86(13)	+ 100	+ 100	– 0	– 0	– 0	V 49	– 0	V 68	+ 100	+ 99	+ 92(8)	+ 96(4)	V 46(34)	– 0	V 28(25)	V 32(25)

*The volume of gas may be small. Gas may not be detected unless incubated at 25°C or in semianaerobic nitrate broth; therefore, in arriving at code numbers, the possibility that this reaction may appear negative was allowed for.

[a] Possibly a biovar of *P. pickettii*

[b] Shown by DNA hybridization to be a biovar of *P. pickettii*

Code Book Pages 368-373

Table 7: Glucose Oxidizers, MacConkey-negative/oxidase-negative

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Urea	Indole	Nitrate Reduction	OF Xylose	OF Sucrose	OF Maltose	Arginine Dihydrolase
Numerical Value of Positive Result					1	2	4	1	2	4	1
Brucella canis	28	+or(+) 81(14)	V 12(29)	V 72	+ 100	– 0	+ 100	+or(+) 81(19)	– 0	– 0	–
*Francisella tularensis**	53	+or(+) 86(14)	– 0	– 2	– 0	– (3)	– 4	–	–	–	–
Pseudomonas mallei	8	+ 100	V 88	V 25	V 12	– 0	+ 100	V 12(50)	– 0	V (75)	+ 100
Pseudomonas pauci-mobilis	134	+ 93(7)	V 10(13)	V 75	– 6(3)	– 0	– 3	+ 96(4)	+ 93(7)	+ 97(3)	– 8
Ile	18	+ 100	– 7	V 88	– 0	+ 100	– 0	– 0	– 0	+ 100	–

*Carbohydrate medium containing cystine or cysteine must be used to demonstrate acid production from carbohydrates. Identification on basis of enhancement of growth by or requirement for cystine or cysteine in media and by serology.

Code Book Page 373

Table 8: Glucose Oxidizers, MacConkey-negative/oxidase-positive

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Indole	Urea	OF Xylose	OF Mannitol	OF Lactose	OF Sucrose	OF Maltose
Numerical Value of Positive Result					1	2	4	1	2	4	1
Brucella species	347	+ or(+) 80(10)	V 23(27)	+ 92	– 0	+ 99	+ 90(10)	– 0	– 0	– 0	– 0
EF-4b	34	+ or(+) 70(26)	V 65(6)	+ 100	– 0	– 0	– 0	– 0	– 0	– 0	– 0
EO-2	93	+ 100	V 63(11)	+ 100	– 0	V 74(3)	+ 99(1)	V 10(10)	+ 91(6)	– 0	V 20(1)
Flavobacterium meningosepticum	148	+ 95(4)	+ or(+) 89(3)	+ 99	+ 100	– 3(5)	– 2(1)	+ 91(8)	V 42(15)	– 0	+ 93(7)
Flavobacterium spiritivorum	11	+ 100	V (55)	+ 100	– 0	+ or(+) 55(36)	+ 91(9)	+ 100	+ 100	+ 100	+ 100
Flavobacterium species (IIb)	155	+ 92(6)	V 54(9)	+ 96	+ 98	V 14(28)	V 30(1)	– 10	– 0	V 13(1)	+ 92(6)
*Neisseria gonorrhoeae**	197	+ 90(3)	– 0	+ 100	–	–	–	– 0	– 0	– 0	– 0
*Neisseria lactamica**	287	+ 96(3)	– 0	+ 100	–	– 0	–	– 0	+ 95(5)	– 0	+ 98(2)
*Neisseria meningitidis**	375	+ 99	– 0	+ 100	–	–	–	– 0	– 0	– 0	+ 99
Pasteurella anatipestifer	1	+	–	+	–	+	–	–	–	–	+
Pseudomonas mallei	8	+ 100	V 88	V 25	– 0	V 12	V 12(50)	V 62(14)	V 12(62)	– 0	V (75)
Pseudomonas mesophilica	90	V 40	V 15	+ 96	– 0	V 29(26)	+ 94	– 2	– 0	– 0	– 2
Pseudomonas paucimobilis	134	+ 93(7)	V 10(13)	V 75	– 0	– 6(3)	+ 6(4)	– 0	+ 93(7)	+ 93(7)	+ 97(3)
Pseudomonas vesicularis	47	+ or(+) 87(9)	V 81(8)	+ 94	– 0	– (8)	V 21(2)	– 0	– 0	– 0	+ 98(2)
IIe	18	+ 100	– 7	V 88	+ 100	– 0	– 0	– 0	– 0	– 0	+ 100
IIh	21	+ or(+) 85(15)	– 0	+ 100	+ 100	– 0	– 5	– 0	– 0	– 0	+ 95
IIi	23	+ 91(9)	– 0	+ 100	+ 100	V 14(18)	+ or(+) 87(13)	– 0	+ 91(9)	+ 91(9)	+ 91(9)

*Carbohydrate reactions obtained in CTA medium. *Neisseria* species also recognized by morphology.

Code Book Pages 373-374

Table 9: Nonoxidizers, MacConkey-positive/oxidase-negative

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	OF Maltose	Motility	Urea	Nitrate Reduction	"Beta" Hemolysis	OF Xylose
Numerical Value of Positive Result					1	2	4	1	2	4
Acinetobacter calcoaceticus (A. lwoffi)	253	– 0	+ 90(7)	– 0	– 0	– 0	– 5(4)	– 3	V 29	– 0
Bordetella parapertussis	7	– 0	+ 100	– 0	– 0	– 0	+ 100	– 0	+ 100	– 0
Brucella canis	28	+or(+) 81(14)	V 12(29)	V 72	– 0	– 0	+ 100	+ 100	– 0	+or(+) 81(19)
Pseudomonas maltophilia	228	+or(+) 85(5)	+ 100	– 0	+ 100	+	V 3(12)	V 29	– 2	V 35(1)

Code Book Page 375

Table 10: Nonoxidizers, MacConkey-positive/oxidase-positive

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	OF Mannitol	OF Xylose	Nitrate to Gas	Nitrate Reduction	H_2S TSI	Urea	Growth on SS	Motility	1-2 Polar Flagella	> 2 Polar Flagella	Peritrichous (lateral & polar)
Numerical Value of Positive Result					1	2	4	1	2	4	1	2	4	1	2
Achromobacter xylosoxidans	135	V 78	+ 100	+ 100	– 0	+ 99	V 60	+ 100	– 0	– 0	+ 98	+	–	–	+
Alcaligenes denitrificans	34	– 0	+ 100	+ 100	– 0	– 0	+ 100	+ 100	– 0	V 12(3)	V 65	+	–	–	+
Alcaligenes faecalis	69	– 0	+ 100	+ 100	– 0	– 0	– 0	V 45	– 0	– (1)	V 78(2)	+	–	–	+
Alcaligenes odorans	49	– 0	+ 100	+ 100	– 0	– 0	– 0	– 0	– 0	– 2	+ 100	+	–	–	+
Bordetella bronchiseptica	85	– 0	+ 100	+ 100	– 1	– 7	– 0	+ 92	– 0	+ 99	+ 99	+	–	–	+
Brucella species	347	+or(+) 80(10)	V 23(27)	+ 92	– 0	+ 90(10)	V 44	+ 100	– 0	+ 99	– 0	–	–	–	–
Campylobacter fetus subsp. *fetus*	113	– 0	+or(+) 83(12)	+ 100	– 0	– 0	– 0	+ 100	– 0	– 0	– 0	+	+	–	–
Campylobacter fetus subsp. *jejuni*	41	– 0	V 44(12)	+ 97	– 0	– 0	– 0	+ 100	– 0	– 0	– 0	+	+	–	–
Flavobacterium odoratum	74	– 0	+ 91(5)	+ 99	– 0	– 0	–	– 0	– 0	+ 100	V 30(11)	–	–	–	–
M-5	59	– 0	V 42(20)	+ 100	– 0	– 0	–	– 0	– 0	– 0	– 0	–	–	–	–
M-6	40	– 0	V 22(28)	+ 100	– 0	– 0	–	+ 100	– 0	– 0	– 0	–	–	–	–
Moraxella atlantae	23	– 0	+or(+) 87(13)	+ 100	– 0	– 0	–	– 5	– 0	– 0	– 0	–	–	–	–
Moraxella osloensis	163	– 0	V [illegible]	+ 100	– 0	– 0	–	V 24	– 0	– 0	– 0	–	–	–	–
Moraxella phenylpyruvica	50	– 0	V 80(6)	+ 100	– 0	– 0	–	V 68	– 0	+ 100	– 0	–	–	–	–
Moraxella urethralis	22	– 0	+ 96	+ 100	– 0	– 0	–	– 0	– 0	– 0	– 9	–	–	–	–
Neisseria flavescens	10	– 0	V 67	+ 100	– 0	–	–	– 0	– 0	– 0	– 0	–	–	–	–
Neisseria mucosa	30	+or(+) 83(10)	V 57(3)	+ 100	– 0	–	+ 100	+ 100	– 0	– 0	– 0	–	–	–	–
Neisseria sicca	43	+or(+) 78(14)	V 68	+ 100	– 0	–	–	– 0	– 0	– 0	– 0	–	–	–	–
Neisseria subflava	153	V 68(6)	V 47(2)	+ 100	– 0	–	–	– 0	– 0	– 0	– 0	–	–	–	–
Pseudomonas acidovorans	64	– 0	+ 100	+ 100	+ 100	– 0	– 0	+ 98	– 0	– (3)	V 67(19)	+	–	+	–
Pseudomonas alcaligenes	26	– 0	+ 96	+ 96	– 0	– 0	– 0	V 54	– 0	– 0	V 38(8)	+	+	–	–
Pseudomonas diminuta	68	V 21(9)	+ 97(3)	+ 100	– 0	– 0	– 0	– 3	– 0	V (13)	– 1(1)	+	+	–	–
Pseudomonas mesophilica	90	V 40	V 15	+ 96	– 2	+ 94	– 0	V 25	– 0	V 29(26)	– 0	+	+	–	–
Pseudomonas pseudoalcaligenes	19	– 0	+ 100	+ 100	– 0	V 32	– 0	+ 90	– 0	– 5	V 84	+	+	–	–
Pseudomonas putrefaciens, biotype 1	24	V 17(33)	+ 100	+ 100	– 0	– 0	– 0	+ 100	+ 96	V 4(8)	– (8)	+	+	–	–
Pseudomonas putrefaciens, biotype 2	26	– 0	+ 100	+ 100	– 0	– 0	– 0	+ 100	+ 100	V 42	+ 92(4)	+	+	–	–
Pseudomonas testosteroni	28	– 0	+ 96(4)	+ 100	– 0	– 0	– 0	+ 96	– 0	V 7(14)	V 21(11)	+	–	+	–
Pseudomonas vesicularis	47	+or(+) 87(9)	V 81(8)	+ 94	– 0	V 21(2)	– 0	– 6	– 0	– (8)	– 6(2)	+	+	–	–
Pseudomonas sp. CDC Group 1	31	– 0	+ 97(3)	+ 100	– 0	– 0	+ 100	+ 100	– 0	V 3(7)	V 30(6)	+	+	–	–
IVc-2	36	– 0	+ 94(6)	+ 100	– 0	– 0	– 0	V 11	– 0	+ 100	– 3(6)	+	–	–	+
IVe	37	– 0	V 62(27)	+ 100	– 0	– 0	V 60	+ 100	– 0	+ 97	– 5	V	–	–	V*
Vd (*Achromobacter* sp.)	71	+or(+) 86(13)	+ 100	+ 100	V 46(34)	+ 96(4)	+ 99	+ 100	V 49	+ 92(8)	+ 96(1)	+	–	–	+

*Motility may be variable, but flagella, if present, are always peritrichous (usually 1-2 polar and/or lateral).

Code Book Pages 375-377

Table 11: Nonoxidizers, MacConkey-negative/oxidase-negative

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Urea	Nitrate Reduction	Motility
Numerical Value of Positive Result					1	2	4
Brucella canis	28	+ or(+) 81(14)	V 12(29)	V 72	+ 100	+ 100	–
Francisella tularensis	53	+ or(+)* 86(14)	– 0	– 2	– 0	– 4	–

*Glucose reaction determined in cysteine agar with phenol red indicator.

Code Book Page 377

Table 12: Nonoxidizers, MacConkey-negative/oxidase-positive

Tests	Number of Strains	Glucose	Growth on MacConkey	Oxidase	Indole	Urea	OF Xylose	Nitrate Reduction	Motility	Catalase
Numerical Value of Positive Result					1	2	4	1	2	4
Bordetella pertussis	51	–	–	+ 94	–	– 0	–	–	–	+ 100
Branhamella catarrhalis	74	– 0	– 5	+ 100	– 0	– 0	– 0	+ 92	–	+ 100
Brucella species	347	+ or(+) 80(10)	V 23(27)	+ 92	– 0	+ 99	+ 90(10)	+ 100	–	+ 100
Campylobacter fetus subsp. *fetus*	113	– 0	+ or(+) 83(12)	+ 100	– 0	– 0	– 0	+ 100	+	+ 99(1)
Campylobacter fetus subsp. *jejuni*	41	– 0	V 44(12)	+ 97	– 0	– 0	– 0	+ 100	+	+ 100
Campylobacter fetus subsp. *venerealis*	2	– 0	– 0	+ 100	– 0	– 0	– 0	+ 100	+	+ 100
Eikenella corrodens	506	– 0	– 0	+ 100	– 0	– 0	– 0	+ 99	–	– 8
M-5	59	– 0	V 42(20)	+ 100	– 0	– 0	– 0	– 0	–	+ 100
M-6	40	– 0	V 22(28)	+ 100	– 0	– 0	– 0	+ 100	–	– 8
Moraxella atlantae	23	– 0	+ or(+) 87(13)	+ 100	– 0	– 0	– 0	– 5	–	+ 91
Moraxella bovis	7	– 0	– 0	+ 100	– 0	– 0	– 0	V 14	– 0	V 14
Moraxella lacunata	25	– 0	– 4	+ 100	– 0	– 0	– 0	+ 100	–	+ 100
Moraxella nonliquefaciens	243	– 0	– 8(2)	+ 100	– 0	– 0	– 0	+ 95	–	+ 95
Moraxella osloensis	163	– 0	V 70	+ 100	– 0	– 0	– 0	V 24	–	+ 95
Moraxella phenylpyruvica	50	– 0	V 80(6)	+ 100	– 0	+ 100	– 0	V 68	–	+ 90
Neisseria elongata	1	–	–	+	–	–	–	–	–	–
Neisseria flavescens	10	– 0	V 67	+ 100	–	– 0	–	– 0	–	+ 100
Neisseria mucosa	30	+ or(+) 83(10)	V 57(3)	+ 100	–	– 0	–	+ 100	–	+ 100
Neisseria sicca	43	+ or(+) 78(14)	V 68	+ 100	–	– 0	–	– 0	–	V 80
Neisseria subflava	153	V 68(6)	V 47(2)	+ 100	–	– 0	–	– 0	–	V 80
Pseudomonas mesophilica	90	V 40	V 15	+ 96	– 0	V 29(26)	+ 94	V 25	V	+ 100
Pseudomonas vesicularis	47	+ or(+) 87(9)	V 81(8)	+ 94	– 0	– (8)	V 21(2)	– 6	+	V 74(11)
IIIf	87	– 0	– (10)	+ 100	+ 100	– 0	– 0	– 0	–	+ 98
IIIj	41	– 0	– 2	+ 100	+ 98	+ 100	– 0	– 0	–	+ 100
IIIe	37	– 0	V 62(27)	+ 100	– 0	+ 97	– 0	+ 100	V	+ 100

Code Book Pages 377-378

GUIDE TO PRESUMPTIVE IDENTIFICATION: CODE BOOK

GLUCOSE FERMENTERS: MacConkey-positive/oxidase negative

These organisms must be differentiated from the species of *Enterobacteriaceae*, which have not been included on the chart.

Numerical Code		Numerical Code	
0000	*Yersinia pestis*	1170	*Chromobacterium violaceum*
0010	*Tatumella ptyseos*	1171	*Chromobacterium violaceum*
0050	*Tatumella ptyseos*	1251	*Yersinia enterocolitica*
0110	*Tatumella ptyseos*	1651	*Yersinia enterocolitica*
0150	*Tatumella ptyseos*	2000	HB-5
0160	*Chromobacterium violaceum*	2160	*Chromobacterium violaceum*
0161	*Chromobacterium violaceum*	2161	*Chromobacterium violaceum*
0170	*Chromobacterium violaceum*	2170	*Chromobacterium violaceum*
0171	*Chromobacterium violaceum*	2171	*Chromobacterium violaceum*
0251	*Yersinia enterocolitica*	2251	*Yersinia enterocolitica*
0410	*Haemophilus aphrophilus*	2651	*Yersinia enterocolitica*
0651	*Yersinia enterocolitica*	3160	*Chromobacterium violaceum*
1000	*Yersinia pseudotuberculosis*	3161	*Chromobacterium violaceum*
1001	*Yersinia pseudotuberculosis*	3170	*Chromobacterium violaceum*
1040	*Yersinia pseudotuberculosis*	3171	*Chromobacterium violaceum*
1041	*Yersinia pseudotuberculosis*	3251	*Yersinia enterocolitica*
1160	*Chromobacterium violaceum*	3651	*Yersinia enterocolitica*
1161	*Chromobacterium violaceum*		

GLUCOSE FERMENTERS: MacConkey-positive/oxidase-positive

Numerical Code	
000	EF-4a: catalase +, 100%; rod; maltose neg., 0%.
	Kingella kingae: catalase neg., 0%; rod; maltose + or (+), 76(24)%.
	Neisseria subflava: catalase v, 80%; coccus; determine reactions for differentiation of *Neisseria* species; maltose +, 99(1)%.
002	*Pasteurella haemolytica:* rarely both mannitol and lactose neg.; beta-like hemolysis v, 72%; rod.
	Pasteurella gallinarum: mannitol and lactose neg., 0%; beta-like hemolysis neg., 0%; rod.
	Neisseria subflava, *Neisseria sicca*, *Neisseria mucosa*: cocci; determine reactions for differentiation of *Neisseria* species.
003	*Pasteurella haemolytica:* acid from xylose v, 66(3)%; catalase v, 84(2)%; beta-like hemolysis v, 72%; usually from animal source.
	Haemophilus aphrophilus: acid from xylose neg., 0%; catalase neg., 5%; beta-like hemolysis neg., 0%; usually from human source.
010	HB-5: catalase neg, 0%; motility neg., 0%.
	Vibrio hollisae: catalase +, 100%; motility v, 50(25)%.
022	*Pasteurella aerogenes:* gas from glucose +, 100%; esculin hydrolysis neg., 0%.
	Actinobacillus suis: gas from glucose neg., 0%; esculin hydrolysis +, 100%.
023	*Pasteurella aerogenes*, *Actinobacillus suis*: see 022

Glucose Fermenters: MacConkey-positive/oxidase-positive (continued)

Numerical Code	
042	*Pasteurella haemolytica*
043	*Pasteurella haemolytica*
062	*Actinobacillus lignieresii:* esculin hydrolysis neg., 0%. *Actinobacillus suis:* esculin hydrolysis +, 100%.
063	*Actinobacillus equuli:* esculin hydrolysis neg., 0%; acid from trehalose +, 100%. *Actinobacillus lignieresii:* esculin hydrolysis neg., 0%; acid from trehalose neg., 0%. *Actinobacillus suis:* esculin hydrolysis +, 100%.
110	*Vibrio vulnificus*
111	*Vibrio vulnificus*
150	*Vibrio vulnificus*
151	*Vibrio vulnificus*
152	*Vibrio alginolyticus*
200	EF-4a: growth on SS neg., 1%; citrate neg., 3(1)%. *Chromobacterium violaceum:* growth on SS + or (+), 71(23)%; citrate v, 68(9)%; usually purple pigmented.
202	*Chromobacterium violaceum*
210	*Chromobacterium violaceum*
212	*Chromobacterium violaceum*
220	*Vibrio damsela:* NaCl required +, 100%; maltose +, 100%; non-pigmented *Chromobacterium violaceum:* NaCl required neg., 0%; maltose neg., 3%; usually purple pigmented.
222	*Chromobacterium violaceum*
230	*Chromobacterium violaceum*
232	*Chromobacterium violaceum*
242	*Vibrio fluvialis*
250	*Aeromonas hydrophila*
251	*Aeromonas hydrophila*
252	*Aeromonas hydrophila:* NaCl required neg., 0%; gelatin hydrolysis +, 96%. *Vibrio fluvialis:* NaCl required +, 100%; growth in 6% NaCl +, 100%; gelatin hydrolysis +, 100%. *Vibrio anguillarum:* NaCl required +; growth in 6% NaCl neg.; gelatin hydrolysis neg. (1 strain).
253	*Aeromonas hydrophilia*
320	*Vibrio damsela*
350	*Aeromonas hydrophila*
351	*Aeromonas hydrophila*
352	*Aeromonas hydrophila*
353	*Aeromonas hydrophila*
402	*Pasteurella gallinarum*
422	*Pasteurella aerogenes*
423	*Pasteurella aerogenes*
432	*Pasteurella pneumotropica*
433	*Pasteurella pneumotropica*
510	*Vibrio vulnificus*
511	*Vibrio vulnificus*
532	*Pasteurella pneumotropica*
533	*Pasteurella pneumotropica*
550	*Vibrio parahaemolyticus:* ONPG neg., 0%; cellobiose neg., 0%. *Vibrio vulnificus:* ONPG +, 100%; cellobiose +, 100%.
551	*Vibrio vulnificus*
552	*Vibrio alginolyticus:* NaCl required +, 100%. *Vibrio cholerae:* NaCl required neg., 0%.
553	*Vibrio cholerae*
711	*Plesiomonas shigelloides*

GLUCOSE FERMENTERS: MacConkey-negative/oxidase-negative

Numerical Code	
000	*Capnocytophaga:* long to filamentous rods; lactose v, 86%. *Gardnerella vaginalis:* short to medium length rods; delayed, incomplete hemolysis on rabbit and human blood agar; lactose neg., 1%.
001	*Capnocytophaga:* continue incubation of xylose for 7 days, neg., 0%; long to filamentous rods. DF-3: continue incubation of xylose for 7 days, + or (+), 86(14)%; predominantly coccoid and short rods.
010	*Capnocytophaga*
011	*Capnocytophaga* DF-3 } see 001
020	*Capnocytophaga* *Gardnerella vaginalis* } see 000
021	*Capnocytophaga* DF-3 } see 001
030	*Capnocytophaga*
031	*Capnocytophaga* DF-3 } see 001
040	*Gardnerella vaginalis*
041	DF-3
046	*Gardnerella vaginalis*
051	DF-3
061	DF-3
071	DF-3
200	*Capnocytophaga*
201	*Capnocytophaga*
210	*Capnocytophaga*
211	*Capnocytophaga*
220	*Capnocytophaga:* urea neg., 0%; mannitol neg., 0%. *Pasteurella ureae:* urea +, 100%; mannitol +, 99(1)%.
221	*Capnocytophaga*
230	*Capnocytophaga:* long to filamentous rods; esculin hydrolysis v, 83%. *Haemophilus aphrophilus:* coccoid to short rods; esculin hydrolysis neg., 0%.
231	*Capnocytophaga*
300	*Actinobacillus actinomycetemcomitans*
320	*Actinobacillus actinomycetemcomitans:* urea neg., 0%. *Pasteurella ureae:* urea +, 100%.
340	*Actinobacillus actinomycetemcomitans*
360	*Actinobacillus actinomycetemcomitans*
401	DF-3
411	DF-3
421	DF-3
431	DF-3
441	DF-3
451	DF-3
461	DF-3
471	DF-3
600	HB-5
700	*Pasteurella multocida*
720	*Pasteurella* sp. "new species 1": ornithine neg., 0%; xylose neg., 0%. *Pasteurella pneumotropica:* ornithine +, 100%; xylose + or (+), 76(19)%.
740	*Pasteurella multocida*
760	*Pasteurella pneumotropica*
770	*Pasteurella pneumotropica*

GLUCOSE FERMENTERS: MacConkey-negative/oxidase-positive

Numerical Code	
0000	*Kingella kingae*
0001	*Kingella kingae:* rod *Neisseria subflava:* coccus
0002	*Kingella kingae*
0003	*Kingella kingae* *Neisseria subflava* } see 0001
0041	*Neisseria subflava:* yellow pigmentation on Loeffler slant +, 99%. *Neisseria sicca:* not pigmented on Leoffler slant.
0043	*Neisseria subflava*
0100	*Kingella denitrificans*
0140	*Pasteurella haemolytica*
0141	*Pasteurella haemolytica:* gas from glucose neg., 0%; catalase v, 84(2)%. *Haemophilus aphrophilus:* gas from glucose +, 98%; catalase neg., 5%.
0142	*Pasteurella haemolytica*
0143	*Pasteurella haemolytica*
0150	*Pasteurella haemolytica*
0151	*Pasteurella haemolytica*
0152	*Pasteurella haemolytica*
0153	*Pasteurella haemolytica*
0160	*Pasteurella haemolytica*
0161	*Pasteurella haemolytica*
0162	*Pasteurella haemolytica*
0163	*Pasteurella haemolytica*
0170	*Pasteurella haemolytica*
0171	*Pasteurella haemolytica*
0172	*Pasteurella haemolytica*
0173	*Pasteurella haemolytica*
0300	*Kingella denitrificans*
1000	DF-2 (if maltose reaction is delayed)
1001	DF-2: long thin rod *Neisseria lactamica:* coccus; ONPG +, 100%. *Neisseria subflava:* coccus; ONPG neg., 0%.
1003	*Neisseria subflava*
1041	*Neisseria subflava* *Neisseria sicca* } see 0041
1043	*Neisseria subflava*
1100	EF-4a: TSI slant acid, neg., 3%. *Actinobacillus actinomycetemcomitans:* no strains have been encountered which were negative in xylose, mannitol, sucrose, and maltose; TSI slant acid, +, 100%.
1101	*Actinobacillus actinomycetemcomitans*
1110	*Actinobacillus actinomycetemcomitans*
1111	*Actinobacillus actinomycetemcomitans*
1120	*Actinobacillus actinomycetemcomitans*
1121	*Actinobacillus actinomycetemcomitans*
1130	*Actinobacillus actinomycetemcomitans*
1131	*Actinobacillus actinomycetemcomitans*
1140	*Pasteurella haemolytica*
1141	*Pasteurella haemolytica:* generally not from an avian source. *Pasteurella gallinarum:* predominantly avian sources.
1142	*Pasteurella haemolytica*
1143	*Pasteurella haemolytica*
1150	*Pasteurella haemolytica*

Glucose Fermenters: MacConkey-negative/oxidase-positive (continued)

Numerical Code	
1151	*Pasteurella haemolytica* *Pasteurella gallinarum* } see 1141
1152	*Pasteurella haemolytica*
1153	*Pasteurella haemolytica*
1160	*Pasteurella haemolytica*
1161	*Pasteurella haemolytica*
1162	*Pasteurella haemolytica*
1163	*Pasteurella haemolytica*
1170	*Pasteurella haemolytica*
1171	*Pasteurella haemolytica*
1172	*Pasteurella haemolytica*
1173	*Pasteurella haemolytica*
1300	EF-4a
1341	*Neisseria mucosa*
1541	*Pasteurella gallinarum*
1551	*Pasteurella gallinarum*
2000	*Cardiobacterium hominis*
2001	*Cardiobacterium hominis*
2020	*Cardiobacterium hominis*
2021	*Cardiobacterium hominis*
2040	*Cardiobacterium hominis:* continue incubation of mannitol, +or(+), 52(43)%; alkaline phosphatase neg.; casein neg.; Tween 20 and 40 hydrolysis neg. *Kingella indologenes:* mannitol neg. at 7 days; alkaline phosphatase +; casein +; Tween 20 and 40 hydrolysis +.
2041	*Cardiobacterium hominis* *Kingella indologenes* } see 2040
2060	*Cardiobacterium hominis*
2061	*Cardiobacterium hominis*
2100	HB-5
3100	*Vibrio hollisae*
3102	*Vibrio hollisae*
3141	*Pasteurella* sp., "new species 1"
3163	*Vibrio anguillarum*
3540	*Pasteurella multocida*
3550	*Pasteurella multocida*
3560	*Pasteurella multocida*
3570	*Pasteurella multocida*
4151	*Actinobacillus suis*
4153	*Actinobacillus suis*
4160	*Actinobacillus lignieresii*
4161	*Actinobacillus lignieresii:* continue incubation of xylose for 7 days, + or(+), 87(13)%; usually animal source or history of animal contact; galactose +, 90(5)%. *Pasteurella ureae:* human sources, mainly respiratory; xylose negative at 7 days; galactose neg., 0%.
4170	*Actinobacillus lignieresii*
4171	*Actinobacillus lignieresii:* esculin neg., 0%,: trehalose neg., 0%. *Actinobacillus suis:* esculin +, 100%; trehalose +, 100%. *Actinobacillus equuli:* esculin neg., 0%; trehalose +, 100%.
4173	*Actinobacillus suis*
5151	*Actinobacillus suis*
5153	*Actinobacillus suis*
5160	*Actinobacillus lignieresii*

Glucose Fermenters: MacConkey-negative/oxidase-positive (continued)

Numerical Code		
5161	*Actinobacillus lignieresii* *Pasteurella ureae*	see 4161
5170	*Actinobacillus lignieresii*	
5171	*Actinobacillus lignieresii* *Actinobacillus suis* *Actinobacillus equuli*	see 4171
5173	*Actinobacillus suis*	
7141	*Pasteurella* sp. "new species 1"	
7541	*Pasteurella pneumotropica*	
7551	*Pasteurella pneumotropica*	

GLUCOSE OXIDIZERS: MacConkey-positive/oxidase-negative

Numerical Code	
010	*Brucella* species, probably *B. canis:* confirm by serology and dye inhibition tests.
022	*Pseudomonas maltophilia*
023	*Pseudomonas maltophilia*
032	*Pseudomonas maltophilia*
033	*Pseudomonas maltophilia*
043	Ye-1
050	*Pseudomonas mallei*
053	Ye-1
102	*Pseudomonas marginata* (one strain): OF maltose neg.; non-pigmented. Ye-2: OF maltose +, 97(3)%; yellow insoluble pigment, 100%.
142	Ye-2
143	Ye-1
150	*Pseudomonas mallei*
153	Ye-1
200	*Acinetobacter calcoaceticus (A. anitratus)*
222	*Pseudomonas maltophilia*
223	*Pseudomonas maltophilia*
232	*Pseudomonas maltophilia*
233	*Pseudomonas maltophilia*
243	Ye-1
250	*Pseudomonas mallei*
253	Ye-1
302	Ye-2: Yellow insoluble pigment +, 100%; H_2S on lead acetate paper over TSI +, 97%; 1-2 polar flagella. *Pseudomonas cepacia:* variable pigmentation; H_2S on lead acetate paper over TSI neg., 0%; >2 polar flagella.
303	*Pseudomonas cepacia*
312	*Pseudomonas cepacia*
313	*Pseudomonas cepacia*
322	*Pseudomonas cepacia*
323	*Pseudomonas cepacia*
332	*Pseudomonas cepacia*
333	*Pseudomonas cepacia*
342	Ye-2
343	Ye-1
350	*Pseudomonas mallei*
353	Ye-1
422	*Pseudomonas maltophilia*
423	*Pseudomonas maltophilia*
432	*Pseudomonas maltophilia*
433	*Pseudomonas maltophilia*
502	Ye-2
542	Ye-2
601	*Pseudomonas paucimobilis*
603	*Pseudomonas paucimobilis*
622	*Pseudomonas maltophilia*
623	*Pseudomonas maltophilia*
632	*Pseudomonas maltophilia*
633	*Pseudomonas maltophilia*

Glucose Oxidizers: MacConkey-positive/oxidase-negative (continued)

Numerical Code		
702	Ve-2 *Pseudomonas cepacia*	see 302
703	*Pseudomonas cepacia*	
712	*Pseudomonas cepacia*	
713	*Pseudomonas cepacia*	
722	*Pseudomonas cepacia*	
723	*Pseudomonas cepacia*	
732	*Pseudomonas cepacia*	
733	*Pseudomonas cepacia*	
742	Ve-2	

GLUCOSE OXIDIZERS: MacConkey-positive/oxidase-positive

Numerical Code	
00002	*Pseudomonas vesicularis*
00010	*Pseudomonas mesophilica*
00012	*Pseudomonas vesicularis*
00050	EO-2
00052	EO-2
00053	*Pseudomonas paucimobilis*
00070	EO-2
00072	EO-2: nonmotile *Pseudomonas thomasii:* motile, <3 polar flagella *Pseudomonas cepacia:* motile, >2 polar flagella
00073	*Agrobacterium radiobacter:* polar & lateral flagella; H_2S (lead acetate)+, 100%. 3-ketolactonate +, 100%. *Pseudomonas cepacia:* polar flagella; H_2S (lead acetate) neg., 0%; 3-ketolactonate neg., 0%. *Flavobacterium spiritivorum:* non-motile; H_2S (lead acetate) v, 56%; 3-ketolactonate neg., 0%.
00100	EF-4b
00110	*Achromobacter xylosoxidans:* citrate +, 95%; peritrichous flagella; growth on SS +, 98%; no pigment. *Pseudomonas mesophilica:* citrate neg., 2(3)%; polar flagella; growth on SS neg., 0%; pink to coral insoluble pigment, +, 99%.
00150	EO-2
00152	EO-2
00170	EO-2
00172	EO-2 *Pseudomonas thomasii* *Pseudomonas cepacia* — see 00072
00173	*Agrobacterium radiobacter* *Pseudomonas cepacia* — see 00073
00310	*Achromobacter xylosoxidans*
00312	*Pseudomonas stutzeri*
00332	*Pseudomonas stutzeri*
00400	*Pseudomonas diminuta*
00410	*Pseudomonas mesophilica*
00450	EO-2
00452	EO-2

Glucose Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code	
00453	*Flavobacterium multivorum*
00470	EO-2
00472	EO-2 *Pseudomonas thomasii* *Pseudomonas cepacia* } see 00072
00473	*Agrobacterium radiobacter* *Pseudomonas cepacia* *Flavobacterium spiritivorum* } see 00073
00510	*Pseudomonas mesophilica:* motile; pink to coral insoluble pigment +, 99%; pleomorphic rods, vacuolated; Simmons citrate neg., 2(3)%. *Brucella:* nonmotile; nonpigmented; tiny, coccoid; Simmons citrate neg., 0%. *Pseudomonas pickettii:* (if gas from nitrate is not detected) weakly motile; nonpigmented; rods (not pleomorphic); Simmons citrate +, 100%.
00550	EO-2
00552	Va-1: motile; rod. EO-2: nonmotile: coccoid.
00570	EO-2
00572	EO-2 *Pseudomonas thomasii* *Pseudomonas cepacia* } see 00072
00573	*Agrobacterium radiobacter* *Pseudomonas cepacia* } see 00073
00710	*Pseudomonas pickettii:* motile, polar flagella; growth on SS neg., 0%; rod. Vd: motile, peritrichous flagella, predominantly polar & lateral; growth on SS +, 96(1)%. *Brucella:* nonmotile; growth on SS neg., 0%; tiny, coccoid.
00711	Vd
00712	*Pseudomonas stutzeri:* motile, polar flagella; H_2S on lead acetate paper v, 36%. Vd: motile, polar and lateral flagella; H_2S on lead acetate paper +, 100%.
00713	Vd
00730	Vd
00731	Vd
00732	*Pseudomonas stutzeri* Vd } see 00712
00733	Vd
00752	Va-1
01073	*Agrobacterium radiobacter*
01103	*Pseudomonas putrefaciens,* biotype 1
01173	*Agrobacterium radiobacter*
01473	*Agrobacterium radiobacter*
01503	*Pseudomonas putrefaciens,* biotype 1
01573	*Agrobacterium radiobacter*
01710	Vd
01711	Vd
01713	Vd
01730	Vd
01731	Vd
01732	Vd
01733	Vd

Glucose Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code	
02072	*Pseudomonas cepacia*
02073	*Pseudomonas cepacia*
02172	*Pseudomonas cepacia*
02173	*Pseudomonas cepacia*
02472	*Pseudomonas cepacia*
02473	*Pseudomonas cepacia*
02572	*Pseudomonas cepacia*
02573	*Pseudomonas cepacia*
04073	*Flavobacterium spiritivorum*
04100	*Pseudomonas mallei*
04102	*Pseudomonas mallei*
04110	*Pseudomonas mallei:* nonmotile; growth on SS neg., 0%; 42°C neg., 0%. *Achromobacter xylosoxidans:* motile; growth on SS +, 98%; 42°C v, 84%.
04112	*Pseudomonas mallei*
04120	*Pseudomonas mallei*
04122	*Pseudomonas mallei*
04130	*Pseudomonas mallei*
04132	*Pseudomonas mallei*
04140	*Pseudomonas mallei*
04142	*Pseudomonas mallei*
04150	*Pseudomonas mallei*
04152	*Pseudomonas mallei*
04160	*Pseudomonas mallei*
04162	*Pseudomonas mallei:* nonmotile. *Pseudomonas pseudomallei:* motile.
04163	*Pseudomonas pseudomallei*
04170	*Pseudomonas mallei*
04172	*Pseudomonas mallei:* nonmotile. *Pseudomonas pseudomallei:* motile.
04173	*Pseudomonas pseudomallei*
04310	*Pseudomonas aeruginosa:* glucose reaction as strong or stronger than xylose reaction; polar flagella; acetamide +, 100%. *Achromobacter xylosoxidans:* xylose reaction stronger than glucose reaction; peritrichous flagella. *Pseudomonas mendocina:* glucose reaction as strong or stronger than xylose reaction, polar flagella; acetamide neg., 0%.
04312	∇b-3
04330	*Pseudomonas aeruginosa*
04332	∇b-3
04362	*Pseudomonas pseudomallei*
04363	*Pseudomonas pseudomallei*
04372	*Pseudomonas pseudomallei*
04373	*Pseudomonas pseudomallei*
04473	*Flavobacterium spiritivorum*
04500	*Pseudomonas mallei*
04502	*Pseudomonas mallei*
04510	*Pseudomonas mallei*
04512	*Pseudomonas mallei*
04520	*Pseudomonas mallei*
04522	*Pseudomonas mallei*
04530	*Pseudomonas mallei*
04532	*Pseudomonas mallei*
04540	*Pseudomonas mallei*

Glucose Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code	
04542	*Pseudomonas mallei*
04550	*Pseudomonas mallei*
04552	*Pseudomonas mallei*
04560	*Pseudomonas mallei*
04562	*Pseudomonas mallei*
04570	*Pseudomonas mallei*
04572	*Pseudomonas mallei*
04710	*Pseudomonas aeruginosa:* acetamide +, 100%; polar flagella; H_2S(PbAc)neg., 4%. *Pseudomonas mendocina:* acetamide neg., 0%; polar flageiia; H_2S(PbAc)+, 100%. ∇d: acetamide neg., 4%; peritrichous flagella, predominantly polar & lateral.
04711	∇d
04712	∇b-3: polar flagella ∇d: polar and lateral flagella
04713	∇d
04730	*Pseudomonas aeruginosa:* acetamide +, 100%; polar flagella. ∇d: acetamide neg., 4%; peritrichous flagella.
04731	∇d
04732	∇b-3, ∇d } see 04712
04733	∇d
04762	*Pseudomonas pseudomallei*
04763	*Pseudomonas pseudomallei*
04772	*Pseudomonas pseudomallei*
04773	*Pseudomonas pseudomallei*
05710	∇d
05711	∇d
05712	∇d
05713	∇d
05730	∇d
05731	∇d
05732	∇d
05733	∇d
14310	*Pseudomonas aeruginosa*
14330	*Pseudomonas aeruginosa*
14710	*Pseudomonas aeruginosa*
14730	*Pseudomonas aeruginosa*
24010	*Pseudomonas fluorescens:* gelatin + at 25°C. *Pseudomonas putida:* gelatin neg. at 25°C.
24011	*Pseudomonas fluorescens*
24012	*Pseudomonas putida*
24030	*Pseudomonas fluorescens*, *Pseudomonas putida* } see 24010
24031	*Pseudomonas fluorescens*
24032	*Pseudomonas putida*
24050	*Pseudomonas fluorescens*, *Pseudomonas putida* } see 24010
24051	*Pseudomonas fluorescens*
24052	*Pseudomonas putida*
24070	*Pseudomonas fluorescens*, *Pseudomonas putida* } see 24010
24071	*Pseudomonas fluorescens*
24072	*Pseudomonas putida*
24110	*Pseudomonas fluorescens*

Glucose Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code		
24111	*Pseudomonas fluorescens*	
24130	*Pseudomonas fluorescens*	
24131	*Pseudomonas fluorescens*	
24150	*Pseudomonas fluorescens*	
24151	*Pseudomonas fluorescens*	
24170	*Pseudomonas fluorescens*	
24171	*Pseudomonas fluorescens*	
24310	*Pseudomonas aeruginosa*	
24330	*Pseudomonas aeruginosa*	
24410	*Pseudomonas fluorescens* *Pseudomonas putida*	see 24010
24411	*Pseudomonas fluorescens*	
24412	*Pseudomonas putida*	
24430	*Pseudomonas fluorescens* *Pseudomonas putida*	see 24010
24431	*Pseudomonas fluorescens*	
24432	*Pseudomonas putida*	
24450	*Pseudomonas fluorescens* *Pseudomonas putida*	see 24010
24451	*Pseudomonas fluorescens*	
24452	*Pseudomonas putida*	
24470	*Pseudomonas fluorescens* *Pseudomonas putida*	see 24010
24471	*Pseudomonas fluorescens*	
24472	*Pseudomonas putida*	
24510	*Pseudomonas fluorescens*	
24511	*Pseudomonas fluorescens*	
24530	*Pseudomonas fluorescens*	
24531	*Pseudomonas fluorescens*	
24550	*Pseudomonas fluorescens*	
24551	*Pseudomonas fluorescens*	
24570	*Pseudomonas fluorescens*	
24571	*Pseudomonas fluorescens*	
24710	*Pseudomonas aeruginosa*	
24730	*Pseudomonas aeruginosa*	
34310	*Pseudomonas aeruginosa*	
34330	*Pseudomonas aeruginosa*	
34710	*Pseudomonas aeruginosa*	
34730	*Pseudomonas aeruginosa*	
40002	*Flavobacterium* sp. (IIb): OF trehalose +, 100% (14 strains); ONPG v, 57% (14 strains); *frank* yellow insoluble pigment +, 99% (155 strains); esculin hydrolysis v, 70% (149 strains). *Flavobacterium breve:* OF trehalose neg., 0% (2 strains); ONPG neg., 0% (3 strains); esculin hydrolysis neg., 0% (3 strains); *slight* yellow insoluble pigment +, 100% (3 strains).	
40003	*Flavobacterium* sp. (IIb)	
40012	*Flavobacterium* sp. (IIb)	
40013	*Flavobacterium* sp. (IIb)	
40022	*Flavobacterium meningosepticum*	
40062	*Flavobacterium meningosepticum*	
40102	*Flavobacterium* sp. (IIb)	
40103	*Flavobacterium* sp. (IIb)	
40112	*Flavobacterium* sp. (IIb)	

Glucose Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code		Numerical Code	
40113	*Flavobacterium* sp. (IIb)	40502	*Flavobacterium* sp. (IIb)
40402	*Flavobacterium* sp. (IIb)	40503	*Flavobacterium* sp. (IIb)
40403	*Flavobacterium* sp. (IIb)	40512	*Flavobacterium* sp. (IIb)
40412	*Flavobacterium* sp. (IIb)	40513	*Flavobacterium* sp. (IIb)
40413	*Flavobacterium* sp. (IIb)		

GLUCOSE OXIDIZERS: MacConkey-negative/oxidase-negative

Numerical Code		Numerical Code	
070	*Pseudomonas paucimobilis*	500	*Brucella* sp., probably *B. canis*
240	IIe	501	*Pseudomonas mallei*
401	*Pseudomonas mallei*	510	*Brucella* sp., probably *B. canis*
411	*Pseudomonas mallei*	511	*Pseudomonas mallei*
441	*Pseudomonas mallei*	541	*Pseudomonas mallei*
451	*Pseudomonas mallei*	551	*Pseudomonas mallei*

GLUCOSE OXIDIZERS: MacConkey-negative/oxidase-positive

(Recognize *Neisseria* by morphology as well as by biochemical reactions)

Numerical Code	
000	*Pseudomonas mallei:* arginine dihydrolase +, 100%; rod. EF-4b: arginine dihydrolase neg., 0%; rod. *Neisseria gonorrhoeae:* coccus.
001	*Pseudomonas mallei:* nonmotile; nitrate reduction +, 100%; arginine dihydrolase +, 100%; rod. *Pseudomonas vesicularis:* motile; nitrate reduction neg., 3%; arginine dihydrolase neg., 0%; rod. *Neisseria meningitidis:* coccus.
010	*Pseudomonas mallei*
011	*Pseudomonas mallei*
020	*Pseudomonas mallei*
021	*Pseudomonas mallei:* rod. *Neisseria lactamica:* coccus.
030	*Pseudomonas mallei*
031	*Pseudomonas mallei*
101	*Flavobacterium* sp. (IIb): esculin hydrolysis v, 70%; insoluble yellow pigment +, 99%. IIe: esculin hydrolysis neg., 0%; insoluble yellow pigment neg., 0%. IIh: esculin hydrolysis +, 100%; insoluble yellow pigment neg., 0%.
111	*Flavobacterium meningosepticum*
131	*Flavobacterium meningosepticum*
141	*Flavobacterium* sp. (IIb)
161	IIi
200	*Pseudomonas mallei*
201	*Pseudomonas mallei:* nitrate reduction +, 100%. *Pasteurella anatipestifer:* nitrate reduction neg. (one strain tested).
210	*Pseudomonas mallei*
211	*Pseudomonas mallei*
220	*Pseudomonas mallei*
221	*Pseudomonas mallei*

Glucose Oxidizers: MacConkey-negative/oxidase-positive (continued)

Numerical Code	
230	*Pseudomonas mallei*
231	*Pseudomonas mallei*
301	*Flavobacterium* sp. (IIb)
341	*Flavobacterium* sp. (IIb)
361	IIi
400	*Pseudomonas mallei:* nonmotile; non-pigmented. *Pseudomonas mesophilica:* motile: pink to coral insoluble pigment +, 99%.
401	*Pseudomonas mallei* *Pseudomonas vesicularis* } see 001
410	*Pseudomonas mallei*
411	*Pseudomonas mallei*
420	*Pseudomonas mallei:* arginine dihydrolase +, 100%. EO-2: arginine dihydrolase neg., 0%.
421	*Pseudomonas mallei* EO-2 } see 420
430	*Pseudomonas mallei* EO-2 } see 420
431	*Pseudomonas mallei* EO-2 } see 420
461	*Pseudomonas paucimobilis*
471	*Flavobacterium spiritivorum*
501	*Flavobacterium* sp. (IIb)
541	*Flavobacterium* sp. (IIb)
561	IIi
600	*Pseudomonas mesophilica:* motile; pink to coral insoluble pigment +, 99%; pleomorphic vacuolated rods. *Brucella:* nonmotile; nonpigmented; tiny, coccoid. *Pseudomonas mallei:* nonmotile; nonpigmented; rod.
601	*Pseudomonas mallei*
610	*Pseudomonas mallei*
611	*Pseudomonas mallei*
620	*Pseudomonas mallei* EO-2 } see 420
621	*Pseudomonas mallei* EO-2 } see 420
630	*Pseudomonas mallei* EO-2 } see 420
631	*Pseudomonas mallei* EO-2 } see 420
671	*Flavobacterium spiritivorum*
701	*Flavobacterium* sp. (IIb)
741	*Flavobacterium* sp. (IIb)
761	IIi

NON-OXIDIZERS: MacConkey-positive/oxidase-negative

Numerical Code	
00	*Acinetobacter calcoaceticus (A. lwoffi, Mima polymorpha)*
02	*Acinetobacter calcoaceticus (A. lwoffi, Mima polymorpha)*
30	*Pseudomonas maltophilia*
31	*Pseudomonas maltophilia*
34	*Pseudomonas maltophilia*
35	*Pseudomonas maltophilia*
41	*Brucella* sp., possibly *B. canis*
42	*Bordetella parapertussis*
45	*Brucella* sp., possibly *B. canis*
70	*Pseudomonas maltophilia*
71	*Pseudomonas maltophilia*
74	*Pseudomonas maltophilia*
75	*Pseudomonas maltophilia*

NON-OXIDIZERS: MacConkey-positive/oxidase-positive

Numerical Code	
0000	*Neisseria flavescens:* coccus; CTA maltose neg., 0%. *Neisseria subflava:* coccus; CTA maltose +, 99(1)%; yellow pigment on Loeffler slant +, 99%. *Neisseria sicca:* coccus; CTA maltose +, 95(5)%; no pigment on Loeffler slant, 0%. *Moraxella osloensis:* short rod; phenylalanine v, 14%; nitrite reduction neg., 0%; *M. osloensis* transformation +. *Moraxella atlantae:* short rod; phenylalanine neg., 0%; nitrite reduction v, 20%; *M. osloensis* transformation neg.; appears fastidious but grows on MacConkey agar. *Moraxella urethralis:* predominantly small coccoid forms; phenylalanine +, 100%; nitrite reduction +, 100%; *M. osloensis* transformation neg. M-5: long rod forms; phenylalanine v, 73%; nitrite reduction v, 84%; *M. osloensis* transformation neg.; associated with dog-bite wounds.
0022	*Alcaligenes faecalis*
0032	*Alcaligenes faecalis:* nitrite reduction neg., 0%; no fruity odor. *Alcaligenes odorans:* nitrite reduction +, 100%; usually has a fruity odor.
0060	*Pseudomonas diminuta:* OF maltose neg., 0%; flagella with short wavelength and low amplitude. *Pseudomonas vesicularis:* OF maltose +, 98(2)%; flagella similar to those of *P. diminuta* but with slightly longer wavelength. *Pseudomonas alcaligenes:* OF maltose neg., 0%; flagella with "normal" wavelength and amplitude.
0070	*Pseudomonas alcaligenes*
0100	*Moraxella osloensis:* catalase +, 95%; nitrite reduction neg., 0%. M-6: catalase neg., 8%; nitrite reduction +, 100% (may require incubation for 48 hr., gas not produced).
0121	*Pseudomonas testosteroni*
0122	*Alcaligenes faecalis*
0131	*Pseudomonas testosteroni*
0132	*Alcaligenes faecalis*

Non-Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code	
0160	*Campylobacter fetus* subspecies *jejuni:* thin, curved, and wavy rods; growth at 42°C; nalidixic acid-sensitive; microaerophilic. *Campylobacter fetus* subspecies *fetus:* thin, curved, and wavy rods; usually no growth at 42°C nalidixic acid-resistant; microaerophilic. *Pseudomonas alcaligenes:* straight or slightly curved rods; OF fructose neg., 0%; growth at 42°C neg., 0%; aerobic. *Pseudomonas pseudoalcaligenes:* straight or slightly curved rods; OF fructose v, 82%; growth at 42°C +, 100%; aerobic.
0170	*Pseudomonas alcaligenes* *Pseudomonas pseudoalcaligenes* } see 0160
0321	*Pseudomonas putrefaciens,* biotype 1
0331	*Pseudomonas putrefaciens,* biotype 2
0400	*Moraxella phenylpyruvica:* nitrite reduction neg., 0%; gelatin hydrolysis neg., 0%; yellow insoluble pigment neg., 0%. *Flavobacterium odoratum:* Nitrite reduction v, 83%; gelatin hydrolysis +, 96%; yellow insoluble pigment v, 85%.
0410	*Flavobacterium odoratum*
0422	IVc-2
0460	*Pseudomonas diminuta*
0500	*Moraxella phenylpyruvica:* coccoid to filamentous thick rods. IVe: small coccoid to short rods, some filaments; motility may be delayed or difficult to detect.
0502	IVe
0520	IVe
0521	*Pseudomonas testosteroni*
0522	IVe: citrate v, 14(16)%; small coccoid to short rods, may have filamentous forms; urine is major source, 92%; predominantly from male patients. IVc-2: citrate +, 100%; medium rods; rarely from urine, 5%.
0531	*Pseudomonas testosteroni*
0532	*Bordetella bronchiseptica*
0760	*Pseudomonas putrefaciens,* biotype 1
0770	*Pseudomonas putrefaciens,* biotype 2
1121	*Pseudomonas acidovorans*
1131	*Pseudomonas acidovorans*
2060	*Pseudomonas mesophilica:* OF maltose neg., 2%; pink to coral insoluble pigment +, 99%; pleomorphic vacuolated rods. *Pseudomonas vesicularis:* OF maltose +, 98(2)%; pink to coral insoluble pigment neg., 0%.
2160	*Pseudomonas pseudoalcaligenes:* pink to coral insoluble pigment neg., 0%; growth at 42°C+, 100%. *Pseudomonas mesophilica:* pink to coral insoluble pigment +, 99%; growth at 42°C neg., 0%; pleomorphic vacuolated rods.
2132	*Achromobacter xylosoxidans*
2170	*Pseudomonas pseudoalcaligenes*
2460	*Pseudomonas mesophilica*
2500	*Brucella*
2560	*Pseudomonas mesophilica*
4100	*Neisseria mucosa*
4122	*Alcaligenes denitrificans*
4132	*Alcaligenes denitrificans*
4160	*Pseudomonas denitrificans*
4170	*Pseudomonas denitrificans*
4500	IVe
4502	IVe
4520	IVe

Non-Oxidizers: MacConkey-positive/oxidase-positive (continued)

Numerical Code	
4522	*Alcaligenes denitrificans:* urea not rapid, "average" length flagella.
	IVe: urea rapid, flagella relatively long.
4532	*Alcaligenes denitrificans*
4560	*Pseudomonas denitrificans*
4570	*Pseudomonas denitrificans*
6132	*Achromobacter xylosoxidans*
6500	*Brucella*
6532	Vd
6732	Vd
7532	Vd
7732	Vd

NON-OXIDIZERS: MacConkey-negative/oxidase-negative

Numerical Code	
0	*Francisella tularensis*
3	*Brucella* sp., possibly *B. canis*

NON-OXIDIZERS: MacConkey-negative/oxidase-positive

Numerical Code	
00	*Neisseria elongata:* rod; gelatin not hydrolyzed.
	Moraxella bovis: rod; gelatin hydrolysis +, 100%; probably an animal source.
	Neisseria subflava: coccus; yellow pigment on Loeffler slant +, 99%.
	Neisseria sicca: coccus; yellow pigment on Loeffler slant, neg., 0%.
01	*Moraxella bovis:* gelatin hydrolysis +, 100%; beta-like hemolysis of blood agar.
	M-6: gelatin hydrolysis neg., 0%; nitrite reduction + without gas, 100%.
	Eikenella corrodens: gelatin hydrolysis neg., 0%; nitrite reduction neg., 0%; lysine v, 82%; ornithine +, 98%.
	Kingella denitrificans: gelatin hydrolysis neg., 0%; nitrite reduction v with gas, 88%.
02	*Pseudomonas vesicularis*
04	*Moraxella osloensis:* rod; gelatin hydrolysis neg., 0%; sodium acetate +, 100%.
	Moraxella bovis: rod; gelatin hydrolysis +, 100%.
	Moraxella atlantae: rod; gelatin hydrolysis neg., 0%.
	M-5: longer rod than generally formed by *Moraxella* species; gelatin hydrolysis neg., 0%; associated with dog-bite wounds.
	Neisseria flavescens: coccus; CTA maltose neg., 0%.
	Neisseria subflava: coccus; CTA maltose +, 99(1)%; yellow pigment on Loeffler slant +, 99%.
	Neisseria sicca: coccus; CTA maltose +, 95(5)%; yellow pigment on Loeffler slant neg., 0%.
	Bordetella pertussis: special media required for growth or enhancement of growth; confirmation by agglutination or direct fluorescent antibody reactions; hemolytic on Bordet-Gengou medium.
05	*Moraxella lacunata:* rod; sodium acetate neg., 7%; digestion of Loeffler slant +, 100%; not hemolytic.
	Moraxella nonliquefaciens: rod; sodium acetate neg., 0%; digestion of Loeffler slant neg., 0%; not hemolytic.
	Moraxella osloensis: rod; sodium acetate +, 100%; digestion of Loeffler slant neg., 0%; not hemolytic.
	Moraxella bovis: rod; beta-like hemolysis +, 100%.
	Branhamella catarrhalis: coccus; gas from nitrate neg., 0%.
	Neisseria mucosa: coccus; gas from nitrate +, 100%.

Non-Oxidizers: MacConkey-negative/oxidase-positive (continued)

Numerical Code	
06	*Pseudomonas vesicularis*
07	*Campylobacter fetus* (all subspecies)
14	IIf
24	*Moraxella phenylpyruvica*
25	*Moraxella phenylpyruvica:* acid from OF xylose, neg. at 7 days, 0%; gas from nitrate neg., 0%. IVe: OF xylose neg. at 7 days; gas from nitrate v, 60%; recheck for motility and/or flagella.
27	IVe
34	IIj
42	*Pseudomonas vesicularis*
44	*Pseudomonas mesophilica*
45	*Pseudomonas mesophilica*
46	*Pseudomonas mesophilica:* acid from OF maltose neg., 2%. *Pseudomonas vesicularis:* acid from OF maltose +, 98(2)%; if OF glucose held for 7 days, will be acid, 96%.
47	*Pseudomonas vesicularis*
64	*Pseudomonas mesophilica*
65	*Pseudomonas mesophilica:* pleomorphic rod; recheck motility (+); pink to coral insoluble pigment. *Brucella:* tiny coccoid forms; recheck motility (−); no insoluble pigment.
66	*Pseudomonas mesophilica*
67	*Pseudomonas mesophilica*